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FINAL REPORT

SEDIMENT SAMPLING WORK PLAN GOWANUS CANAL AND BAY ECOLOGICAL RESTORATION PROJECT

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1.0 INTRODUCTION AND PURPOSE

Under the Hudson-Raritan Estuary (HRE) Project, the U.S. Army Corps of Engineers (USACE), New York District (NYD) is currently performing an Ecological Restoration Project focused on the Gowanus Canal, Gowanus Bay and surrounding upland. The HRE evaluation program includes all waters of the New York and New Jersey harbor, and tidally influenced portions of all rivers and streams that empty into and/or ecologically influence the harbors. The HRE Project has identified three spin-off sites, which are areas where separate studies are proposed as appropriate because those studies contribute to an overall understanding of the ecosystem. The Gowanus Canal and Gowanus Bay have been identified as one of the spin-off site under the HRE Project.

As part of the Gowanus Bay and Gowanus Canal Ecological Restoration Project, the USACE is assessing sediment quality within the Gowanus Canal. The Gowanus Canal proper is a highly developed urban area located in Brooklyn, New York and is bordered by residential communities such as Carroll Gardens, and Red Hook. The canal is impacted by poor water quality, contaminated sediments containing a variety of inorganic and organic constituents, and a poor benthic community structure as the result of a century of heavy industrial use.

As part of historic environmental evaluation activities, the USACE collected sediment samples from 30 locations beginning at the head of the Gowanus Canal into Gowanus Bay. Samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), Resource Conservation and Recovery Act (RCRA) metals, mercury, and total petroleum hydrocarbons (TPH). Samples also received bacteriological analysis. The USACE was presented with an evaluation of that data in the *Sediment Quality Evaluation Report, Gowanus Canal and Bay Ecological Restoration Project*, dated October 2004.

As part of Phase 2 investigative activities within the Gowanus Canal, the U.S. Environmental Protection Agency (USEPA) will be collecting sediment samples at ten new locations within the

Gowanus Canal on behalf of the USACE. Sediment samples will be analyzed for USEPA Target Compound List (TCL), VOCs, SVOCs, priority pollutant metals, and pesticides, PCBs, TPH, and RCRA waste characterization analyses (through a “Priority Pollutant + 40” analysis). The objective of this sampling will be to assist with decisions regarding remedial actions and potential beneficial reuse of the remediated sediment to be made.

Under DACW51-01-D-0017-2, Delivery Order Number 0046, USACE has requested technical support relative to the proposed sediment sampling identification to be conducted by the USEPA. As part of that technical support, this sediment sampling work plan has been prepared outlining the technical approaches to be used in the collection of the planned sediment samples.

2.0 SITE DESCRIPTION AND HISTORY

This section presents a brief summary of the physical characteristics of the Gowanus Canal and describes the USACE program that provided historic information regarding sediment quality within the Gowanus Canal.

2.1 SITE DESCRIPTION

The Gowanus Canal and Gowanus Bay are located in Kings County (Brooklyn), New York and are part of the New York Harbor Estuary (see Figure 1). The Gowanus Canal was built in 1881 to facilitate commercial shipping, barge traffic and other commercial users by digging out the Gowanus Creek. For much of its length, the Gowanus Canal is relatively narrow, with its banks stabilized by piers or bulkheads.

The elevation of the land surrounding the Gowanus Canal generally ranges from 0 to 30 feet above Mean Sea Level (MSL). Stormwater from the surrounding neighborhoods drains into the Gowanus Canal. The Gowanus Bay extends from Bay Ridge Channel to the beginning of the Gowanus Canal at Hamilton Avenue. The Gowanus Canal extends from Hamilton Avenue to Butler Street in Brooklyn (approximately two miles in length). Together, the Gowanus Canal and Gowanus Bay cover approximately 130 acres. The watershed feeding into the Gowanus Canal is approximately six square miles in area.

The Canal passes through a heavily urbanized section of Brooklyn that is bordered by residential communities such as Park Slope, Carroll Gardens, and Red Hook. Throughout its history, the Canal has provided commercial shipping access for a variety of industries, including oil refineries, machine shops, manufactured gas plants (MGP), chemical plants, soap makers and tanneries. The Canal is under severe environmental stress from a number of chemical releases and spills as a result of the over 100 years of industrial use. Stormwater and numerous CSOs discharging into the Canal have resulted in the continual release of contaminants into the Canal. While the canal was constructed in 1881, it was not until 1987 that a sewage treatment plant

(Red Hook Wastewater Treatment plant) was constructed in an effort to improve the area's sewage problem and limit the load of contaminants being discharged into the Canal.

The narrow width of the canal, coupled with its long reach from the bay, has limited the ability of tidal movement to flush contaminants from the system, resulting in a semi-stagnant body of water. In 1911, a water circulation system was constructed to bring water into the Canal from the New York Harbor to increase the movement of water within the canal (called the Gowanus Flushing Tunnel). The system operated until the mid-1960's at which time it ceased operation due to mechanical failure. The system was reactivated in April 1999.

2.2 HISTORIC USACE SEDIMENT SAMPLING PROGRAM

The USACE collected sediment samples from the Gowanus Canal and Gowanus Bay in April and May 2003 as part of the Ecological Restoration Project. The purposes of the study were to assess the condition of the aquatic ecosystem, identify restoration opportunities, and select the best alternative for ecosystem restoration. The sediment-sampling program developed baseline information regarding sediment quality that was used to identify areas of concern in the Gowanus Canal and the Gowanus Bay. The sampling also provided data regarding the geotechnical, chemical and bacteriological condition of the sediments within these waterbodies.

As shown on Figure 2, the USACE collected sediment samples from 30 locations beginning from the head of the Gowanus Canal to about the mid-point of the Gowanus Bay. As noted in USACE (2003), samples were collected using two-foot long 1-3/8 inch (ID) split spoon samplers. Samples were generally collected to about 30 feet below (-30 feet) Mean Lower Low Water within the Gowanus Canal and 40 feet below (-40 feet) Mean Lower Low Water within the Gowanus Bay.

The sediments were analyzed for the following constituents:

- Volatile organics utilizing EPA SW-846 Method 8260;
- Semi-volatile organics utilizing EPA SW-846 Method 8270;

- Pesticides and PCBs utilizing EPA SW-846 Method 8081/8082;
- RCRA metals utilizing EPA SW-846 Methods 3051 and 6010B;
- Mercury utilizing EPA SW-846 7471B;
- Total petroleum hydrocarbons utilizing NJDEP Method OQA-QAM-025; and
- Bacteriological analysis.

Not every one of the above analytes was analyzed at every sampling location. A full description of sampling methodologies and approaches for all geotechnical, chemical and bacteriological sampling within the Gowanus Canal and Gowanus Bay can be found in USACE (2003).

An evaluation of the sediment data collected by the USACE was completed as part of DACW51-01-D-0017, Delivery Order Number 0017 and presented to the USACE in a report titled *Sediment Quality Evaluation Report, Gowanus Canal and Bay Ecological Restoration Project*, dated October 2004. The evaluation was a tiered process that began with the comparison of the sediment sampling results to sediment quality benchmarks. If a constituent at any given sampling location exceeded a benchmark (or if a benchmark was not available), it was then carried to the next step, which was a comparison to the background loading of contaminants found within the New York Harbor.

For constituents that exceeded both their respective sediment screening value and their regional background value, a final step was applied to evaluate the relative hazards associated with each sampling station. For each constituent, a numerical rating between 1 and 5 (one being best, five being worst) was assigned in the categories of toxicity, bioaccumulation potential, persistence, and bioavailability. The rating was assigned based on professional judgment following a review of the literature regarding the chemical makeup of each analyte. Then, at each sampling location, the numerical ratings of the organic compounds and inorganic constituents that exceeded their benchmark and their background value (or for which there was no benchmark or background) were summed to get a total hazard rating. A sample-specific weighting factor based on the level of benchmark exceedance was also utilized.

The results of the sediment sampling conducted by the USACE indicated that a variety of organic and inorganic constituents are present throughout the Gowanus Canal and Gowanus Bay. Concentrations of the constituents were higher at upstream locations where tidal flushing is at a minimum and where the greatest residence time for constituents that have been released into the canal would occur.

In general, the number of constituents that exceeded their respective sediment screening criteria increased the further upstream the samples were collected (see Table 1). The exception to this is at the very end of the Gowanus Canal where the actions of the Gowanus Flushing Tunnel, which was built in 1911 and reactivated in 1999 to increase water circulation at the end of the Canal, has resulted in an improvement in sediment quality because of the increased flushing and aeration. In the majority of the downstream locations, inorganic constituents dominated the exceedances. For example, the furthest downstream location had eleven constituents that exceeded benchmarks (or for which benchmarks were not available). Of those, ten were inorganic constituents. In the middle section of the Gowanus Canal, the exceedances were dominated by polycyclic aromatic hydrocarbons (PAHs). Towards the end of the Gowanus Canal, the exceedances were equally distributed between the various classes of analytes.

The samples that were collected within the Gowanus Bay generally had lower numbers of constituents that exceeded both sediment screening benchmark values and average background numbers (see Table 2 and Table 3). The majority of the constituents that were in exceedance were metals. Within the bay there were areas that had a number of organic constituents that exceeded both sediment quality benchmarks and average background values, or that had constituents for which there is no background or benchmark. However, the Canal samples showed a progressively larger number of constituents that exceeded both sediment quality benchmarks and average background values than seen in the bay. Exceedance within the Canal increased in an upstream direction.

The results of the hazard ranking confirmed the trends observed in the other data evaluation steps. That is, the hazard values generally increased from the downstream sampling locations to the upstream sampling locations (see Table 4). The samples in the Gowanus Bay had the lowest

benthic hazard values, while the highest benthic hazard values were found in the in the sediment sample locations upstream in the Gowanus Canal. However, the two highest benthic hazard values were in the middle section of the canal. In both instances, the hazard scores were driven by a large number of PAHs that were present at high concentrations.

USACE conducted bacteriological analysis on 25 of the collected samples. The bacteria that were identified in the sediment samples included bacterial specimens that are commonly found in the environment and do not have any affect on humans, as well as those that can be infectious upon coming in contact with humans. Several of the species are commonly found in human gastrointestinal tracts and are components of human waste and sewage.

2.3 PHYSICAL CHARACTERIZATION OF SEDIMENTS IN THE GOWANUS CANAL

As noted in USACE (2003), the bottom of the Gowanus Canal was covered by a soft, dark gray to black, highly plastic layer of clay, with few exceptions. This clay unit typically had a decaying organic odor associated with it and weak petroleum-type sheens were noted in some samples. Beneath the clay layer, the deeper sediments were characterized as sands, silty sands, and poorly graded sands, often with traces of gravel.

3.0 FIELD SAMPLING PLAN

Detailed procedures for sample collection, handling, and shipping are described in this section. Procedures are included for the following items:

- Station locations and sample types;
- Sample identifiers;
- Sampling procedures; and
- Documentation.

The anticipated schedule of sample collection and safety considerations is also discussed in this section.

3.1 SAMPLE LOCATIONS

Ten new locations within the Gowanus Canal were chosen for sediment sampling purposes as part of the Phase 2 sediment sampling to be conducted by the USEPA on behalf of the USACE.

The new locations were chosen with the understanding that the purpose of the samples is to characterize sediments for purposes of beneficial reuse and remedial decisions. It is understood that these sample will be analyzed for a broad spectrum of analytes. It is also understood that the USACE, under a different contracting mechanism, will be collecting additional sediment samples at the existing sampling locations at some point in the future. Those samples will be analyzed for a more refined list of analytical parameters and the results will be used in further risk and habitat evaluations. All of the Phase 2 sampling planned for the Gowanus Canal will focus on the top biologically active stratum of sediment (zero to two feet below the top of sediment).

Noting that the upper stratum of sediment will be sampled at the old sampling locations (though not with the breadth of analytical techniques as previous used), the proposed Phase 2 sample

locations should fill data gaps in the understanding of sediment quality. As only ten samples can be collected, their position should be such that they maximize the spatial coverage of sediment sampling. Additionally, the Phase 2 samples should be combined with the existing data to develop approaches to remediation and restoration.

On examining the results of the 2004 sediment quality evaluation, it was decided that any additional sampling should focus on the areas of the Gowanus where the completion of a remedial action is more critical. The benthic hazard index (see Figure 3) depicts that, with a few exceptions, there is a marked increase in the value of the scores (the threat posed to benthic invertebrates) at a point about ½ way up the canal (in the vicinity of the former sampling location 14). This is the area in the canal that is just upstream of the Gowanus Expressway overpass. Downstream of that point, the hazard index values are significantly lower. Additionally, the scores downstream of former sampling location 14 do not differ significantly as you move downstream, nor are the scores significantly different than the values in the Gowanus Bay. The values in the Bay would be reflective of background conditions within the New York Harbor complex.

For the most part, the proposed sample locations were placed between existing sample locations so as to give a broader understanding of sediment quality. The benthic hazard index values from former location 14, upstream to former location 30, were fairly uniform and significantly larger than those downstream of former location 14. By placing the new samples within the gaps of the old samples, a more uniform understanding of the sediments can be developed.

There were some exceptions to this approach. No new samples were placed between old location 25 and 21, as there appears to be good coverage for that reach of the canal. New samples were not placed between former location 18 and former location 15 along the linear length of the Gowanus because of the relatively short distance. However, a new sample was placed between former location 15 and former location 16 in the 7th Street Basin; and between former location 18 and former location 19 in the 6th Street Basin. In both instances, sampling problems during the historic sediment sampling kept the samples at the terminus of each of the Basins (former location 16 and former location 19) from being analyzed. Collecting a new

sample for a full analysis, to be considered with the future data from the former locations, should provide sufficient data to assess data quality for reuse and remedial options in the Basins.

The proposed sediment sample locations are presented on Figure 4.

3.2 SAMPLING PROCEDURES

The purpose of sediment sampling is to acquire accurate, representative information about the chemical conditions of the sediment either at the sediment/surface water interface or at representative depths below the sediment surface. This will be accomplished by characterizing sediment strata, classifying sediment materials, and collecting samples for analysis by chemical methods.

Sediment sampling will be conducted using sampling devices designed to collect a specified volume and surface area of sediment, from a required depth below the surface of the sediment. Sediment sampling will be conducted in such a manner as to maintain the integrity of the collected sediment, to the maximum extent possible.

3.2.1 Inspection of Equipment

The collection of reliable samples of sediment depends partially on the type of samples that can be collected when using various sampling techniques. No matter which sampling method is chosen, the sampling equipment shall be inspected prior to commencement of sampling for signs of equipment deterioration or breakage.

3.2.2 Equipment Decontamination

To ensure that cross-contamination does not occur, all equipment utilized for sediment sampling shall be thoroughly decontaminated as described in the procedure on decontamination (see Section 3.4). At a minimum, all equipment shall be steam-cleaned or undergo a wash and rinse process. All wash and rinse water shall be collected, containerized, and properly labeled. Clean

equipment shall not come into contact with contaminated sediments or other contaminated materials. Equipment shall be kept on plastic or protected in another suitable fashion.

3.2.3 Use of the Sampling Device

Sediment sampling to be conducted by the USEPA in the Gowanus Canal on behalf of the USACE will be accomplished using a sediment grab sampler. Sediment grab samplers are generally box shaped devices that are manually or mechanically lowered to the sediment surface and then actuated to collect the sediment sample. The samplers contain a set of jaws or rotating bucket to trap the sediment. The penetration of the sampler is generally only as deep as the jaws or bucket can reach. The most commonly used grab samplers include Ponar, Van Veen, and Peterson. A grab sampler that can reach the desired depth of penetration must be selected.

The steps required to obtain a representative sediment sample using a grab sampler are presented below.

- The support boat is positioned over the sampling location using bearings from near shore landmarks and the actual positioned fixed with a GPS locator;
- The properly decontaminated grab sampler is lowered to the sediment surface and the jaws are actuated to collect the sample;
- The sampler is then pulled to the boat gently to prevent fine sediment washout;
- Once in the boat, the sampler is placed in mixing bowl and opened;
- Thoroughly homogenize sediment samples in decontaminated stainless steel bowls for preparation for laboratory analysis;
- Repeat as necessary in order to obtain enough sediment for analysis. Homogenize all retrieved material into the appropriate decontaminated bowls prior to placing in sample bottles;
- Obtain sample from bowl with a decontaminated scoop, place in appropriate sample containers, and tighten cap;

- The sample shall then be labeled according to procedure FP-F-6 and immediately placed on ice in a cooler; and
- The sediment is classified using the Unified Soil Classification system and entered into the field notebook;

3.2.4 Field Measurements

At each sample location, field measurements of general water quality will be obtained with a portable electronic water quality monitor (Horiba or equivalent). Measurements will include temperature, dissolved oxygen, pH, conductivity, and salinity. Qualitative observations of water conditions (turbidity, presence of floating objects and debris) will also be made at each location.

3.3 SAMPLE ANALYSIS

Sediment samples will be analyzed using the following analytical techniques:

- Target Compound List Organics using EPA CLP, includes
 - Volatile organics;
 - Semi-volatile organics;
 - Pesticides and PCBs;
- Priority Pollutant metals utilizing EPA SW-846;
- RCRA waste characterization (ignitability, corrosivity, reactivity)
- Total petroleum hydrocarbons utilizing NJDEP Method OQA-QAM-025;
- Total Organic Carbon (TOC) using Standard Method 5310B; and
- Grain size using Method ASTM D-422.

3.4 SAMPLE LABELING

A sample label shall be affixed to each individual sample container. Clear tape will then be placed over each label to prevent the labels from tearing or falling off and to prevent loss of

information on the label. The following information shall be recorded with a waterproof marker on each label:

- Project name;
- Project number (if applicable);
- Sample identification number;
- Date and time of collection;
- Sampler's initials;
- Sample preservatives (if applicable); and
- Analysis to be performed on sample.

3.5 SAMPLE HANDLING AND SHIPMENT

All appropriate U.S. Department of Transportation regulations (e.g., 49 CFR, Parts 100-199) shall be followed in shipment of air, soil and water samples collected during monitoring programs. Procedures include those listed in this subsection.

Immediately following collection, all samples will be labeled according to the procedures outlined in Section 3.5. The lids of the containers shall not be sealed with duct tape, but may be covered with custody seals or placed directly into self-sealing bags. The sample containers will be placed in an insulated cooler with frozen gel packs (such as "blue ice") or ice in double, sealed zip-lock bags. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. Prior to shipping, glass sample containers should be wrapped on the sides, tops, and bottoms with bubble wrap or other appropriate padding to prevent breakage during transport. Samples shall be shipped as soon as possible to allow the laboratory to meet holding times for analyses. Prior to shipment, the ice or cold packs in the coolers will be replaced so that samples will be maintained as close to 4°C as possible from the time of collection through transport of the samples to the analytical laboratory.

Another activity that may be performed to keep samples as close to 4°C as possible during sample storage and transport is to place dry ice in the cooler with the samples during sample

collection. If dry ice should be removed prior to shipment, it should be replaced with ice in double, sealed ziplock bags or frozen gel packs. Dry ice should only be used with non-glass sample containers, since the dry ice may freeze the samples. Prior to shipment, containers previously packed with dry ice should be placed in coolers with glass samples in containers to provide additional sample cooling effects.

When a cooler is ready for shipment to the laboratory, two copies of the chain-of-custody form shall be placed inside a zip-lock bag and taped to the inside of the cooler. The coolers will then be sealed with strapping tape and labeled "Fragile," "This-End-Up" or other appropriate notices. A letter stating the names and telephone numbers of USEPA/USACE and laboratory personnel at various locations who can be contacted in the event of problems with the sample shipment should also be taped to the outside of the cooler. Chain-of-custody seals will be placed on the coolers.

Upon receipt of sample coolers at the laboratory, the sample custodian shall inspect the sample containers. The samples shall then be immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

3.6 CUSTODY PROCEDURES

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Custody of samples shall be maintained in accordance with EPA chain-of-custody guidelines as prescribed in EPA *NEIC Policies and Procedures*, National Enforcement Investigations Center, Denver, Colorado, revised May 1986; EPA's *RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD)*, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA OSWER Directive 9355 3-01), Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*, and *Test Methods for Evaluating Solid Waste* (EPA SW-846).

According to EPA's *NEIC Policies and Procedures*, a sample is considered to be in custody if:

- It is in one's actual physical possession or view;
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal);
- It is retained in a secured area with restricted access; or
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

Custody seals shall be placed on shipping coolers if the cooler is to be removed from the sampler's custody. Custody seals will be placed in such a manner that they must be broken to open the containers or coolers. The custody seals shall be labeled with the following information:

- Sampler's initials; and
- Date and time that the sample/cooler was sealed.

These seals are designed to enable detection of sample tampering.

Field personnel shall also log individual samples onto carbon copy chain-of-custody forms when a sample is collected, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The samplers will also sign the custody form signifying that they were the personnel who collected the samples. The chain-of-custody form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the person delivering the samples for transport will sign and indicate the date and time on the accompanying chain-of-custody form. One copy of the chain-of-custody form will be retained by the sampler and the remaining copies of the chain-of-custody form shall be placed inside a zip-lock bag and taped to the inside of the cooler. Each cooler must be associated with a unique chain-of-custody form. Whenever a transfer of custody takes place, both parties shall

sign and date the accompanying carbon copy chain-of-custody forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy. The laboratory shall attach a copy of the completed chain-of-custody forms to the reports containing the results of the analytical tests.

3.7 LABORATORY CUSTODY PROCEDURES

The following are custody procedures to be followed by an independent laboratory receiving samples for chemical analysis. A designated sample custodian shall take custody of all samples upon their arrival at the analytical laboratory. The custodian shall inspect all sample labels and custody forms to ensure that the information is consistent, and that each is properly completed. The custodian will also measure the temperature of the samples in the coolers upon arrival. The custodian shall also note the condition of the samples including:

- If the samples show signs of damage or tampering;
- If the containers are broken or leaking;
- If headspace is present in sample vials; and
- If any sample holding times have been exceeded.

The custodian shall document all of the above information on a sample receipt sheet. The custodian shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4°C. The unique laboratory number for each sample, the field sample ID, the client name, date and time received, analysis due date, and storage shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The custodian shall also sign the shipping bill and maintain a copy.

Laboratory personnel will be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in

and out on internal laboratory chain-of-custody forms each time they are removed from storage for extraction or analysis.

3.8 DECONTAMINATION

All re-usable sampling equipment will be decontaminated between each use to ensure the integrity of each of the representative surface water and sediment samples. The decontamination procedure shall consist of the following:

- 1) Wash with a non-phosphate detergent (alconox, liquinox, or other suitable detergent) and potable water solution (the decontamination fluids shall be changed after each decontamination cycle),
- 2) Rinse with potable water,
- 3) Rinse with deionized water.

Isopropyl alcohol may also be used, only when necessary, to aid in decontaminating sampling devices that cannot be rendered visibly clean with the detergent wash and rinse sequence. Rinse sequence must be repeated if additional decontamination is required.

Submersible pumps (if used for sampling) require additional effort to properly decontaminate because internal surfaces become contaminated during usage. These pumps shall be decontaminated by steam cleaning or by washing and rinsing the outside surfaces using the procedure described for small equipment. The internal surfaces shall be decontaminated by recirculating fluids through the pump while it is operating. The decontamination sequence shall include:

- 1) Detergent and potable water wash;
- 2) Potable water rinse; and
- 3) The decontamination fluids shall be changed after each decontamination cycle.

Equipment for measuring field parameters such as water levels, pH, temperature, specific conductivity, and turbidity shall be rinsed with per manufacturer specifications between sampling locations.

Personnel responsible for equipment decon, must wear the PPE specified in the site- specific Health and Safety Plan (HASP). In addition to the aforementioned precautions, the following safe work practices will be employed:

Chemical Hazards Associated With Equipment Decontamination:

- 1) Avoid skin contact with and/or incidental ingestion of decon solutions and water.
- 2) Utilize PPE, as specified in the site-specific HSP, for splash protection.
- 3) Refer to Material Safety Data Sheets (MSDSs), safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE - skin, respiratory, etc.).
- 4) Take necessary precautions when handling detergents and reagents.

Physical Hazards Associated With Equipment Decontamination:

- 1) To avoid heat stress, over exertion, and exhaustion, it is a recommended AMEC health and safety policy that equipment decon be rotated among all AMEC site personnel.
- 2) Take necessary precautions when handling field sampling equipment.

3.9 DOCUMENTATION

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record-keeping and chain-of-custody procedures will be implemented to allow samples to be traced from collection to final disposition. Various logs and forms required to adequately identify and catalog station and sample information include the following:

➤ **Field Logbook** - Work conducted during the course of the sediment-sampling program will be documented so as to provide a concise, permanent record of field activities. A daily field logbook will be kept as the primary record for documenting all investigative activities. Field logbooks will be bound and will have numbered, water-resistant pages. Pertinent information regarding the areas of investigation and sampling procedures will be documented, with notations made in logbook fashion, noting the time and date of entries. Information recorded in the logbook will include, but not be limited to, the following information:

1. Date and time of onsite arrival/departure;
2. Name of person keeping the logbook;
3. Names of personnel present and associated with the daily field activities;
4. Daily objective;
5. Sketch of sampling locations in relation to landmarks;
6. Samples collected;
7. Methods used in sample collection;
8. Media sampled and parameters to be analyzed for;
9. GPS location and visual bearings from sampling locations;
10. Qualitative observations of biota and biological conditions;
11. Weather conditions
12. Description of photographs taken

Each gear deployment event will also be recorded in the field logbook. The station name, date, gear, cast number, water depth, time, and location coordinates will be recorded on each log sheet. Penetration depth, sediment type, sediment color, and sediment odor will also be recorded for sediment samples. The sample type, sample identifier, and sample number will also be recorded on the station/sample log sheet.

➤ **Chain-of-Custody Form** - The sample and tag numbers of each sample container will be recorded on a chain-of-custody form. This form will also identify the sample collection date and time, the type of sample, the project, and the person responsible

for sample handling. The chain-of-custody form will be sent to the laboratory along with the sample. Chain-of-custody forms will be completed in triplicate with the field team leader retaining one copy.

- **Sample Label and Custody Seal** - A sample label will be completed for each sample. Sample containers will be labeled at the time of sampling with the following information: sample number, site name, sampling date and time, sampling personnel, preservative (if appropriate), and tag number. A custody seal will be placed across the lid of the cooler prior to shipping.

At the end of each day and prior to shipping or storage, chain-of-custody entries will be made for all samples. Finally, information on the labels will be checked against station/sample log entries, and samples will be re-counted.

The field team leader is responsible for properly completing all forms. Chain-of-custody and sample analysis request forms will be completed and signed before the end of each sampling day and before they are shipped off to the laboratory. Chain-of-custody forms will be signed at each point of transfer between the field and the laboratory and within the laboratory. The field team leader will retain copies of all forms. Any changes in the sampling procedures described in this work plan will be documented in the field notebook.

3.10 SAMPLING SEQUENCE

The sequence of sample collection will be arranged to maximize efficiency while minimizing potential cross-sample contamination. Logistics of reaching shallow sampling locations may depend on tidal cycles. Where logistics and time permit, sampling will be performed from a downstream to upstream sequence. The appropriate sampling sequence will be determined in the field by the field team leader.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The following sections outline the quality assurance/quality control (QA/QC) procedures to be followed as part of this supplemental sampling.

4.1 DATA QUALITY OBJECTIVES

To ensure that sufficient and accurate data are collected for site characterization and selection of remedial actions, data quality objectives are routinely defined for multi-media sampling efforts. Based on data quality objectives, Quality Assurance/Quality Control (QA/QC) protocols are identified. Data Quality Objectives (DQOs) ensure that the proper data are collected and generated to answer environmental questions regarding a specific analytical problem. As such, different data uses may require different levels of data collection. Two levels of data collection (field analysis and definitive) are described below.

- **Field Analysis** – Field analysis provides qualitative or semi-quantitative results. These types of data include those generated on-site through the use of photoionization detectors (PIDs), pH/conductivity meters, or other real time instrumentation. Field analysis may also include chemical characterization with instruments such as field operated gas chromatography equipment to produce data in a timely manner. Field chemical analysis data that are generated to make site decisions, using abbreviated analytical methods, are typically supported by laboratory analysis (usually ten percent) using a definitive determinative method.

For this investigation, the only field analyses required will be general water quality measurements. This will involve field measurements of temperature, dissolve oxygen, conductivity and salinity at all sampling locations.

- **Definitive Analysis** - Analyses performed at off-site laboratories using standard USEPA determinative methods provide definitive analysis results. Deliverables

provided include the detailed QA/QC supporting documentation normally required under a Certified Laboratory Program (CLP) or analogous programs.

Unless otherwise specified, all solid and aqueous samples collected for chemical analyses during the investigation will be analyzed as definitive analytical samples. A laboratory certified under the New York State Department of Health's Environmental Laboratory Approval Program (ELAP) for Contract Laboratory Protocols (CLP) will perform the definitive analyses. Although CLP methods will not be required for the Supplemental Sediment Investigation, analytical data will be reported in the NYSDEC Analytical Services Protocol (ASP) Category B deliverables format.

Samples analyzed for grain size will be analyzed in a materials testing laboratory that is not subject to the ELAP/CLP certification requirements. Materials testing will include routine QA/QC documentation specified by the test methods.

4.2 MEASUREMENT PERFORMANCE CRITERIA

Protocols that will ensure data accuracy, precision, representativeness, comparability, completeness, and sensitivity are presented in this section.

4.2.1 Data Accuracy

Accuracy is defined as the degree of agreement of a measurement or average of measurements with an accepted reference or "true" value. Accuracy will be evaluated by use of calibration and calibration verification procedures, laboratory control samples, surrogate, and matrix spikes at the frequencies specified in the analytical method. Accuracy will be calculated as percent recovery and will be evaluated by the acceptance criteria specified in each analytical method.

4.2.2 Data Precision

Precision is defined as a measure of mutual agreement among individual measurements of the sample property. Precision will be evaluated by the analysis of laboratory duplicates and matrix spike duplicates at rates specified in the analytical methods. Precision will be calculated as relative percent difference and will be evaluated by the acceptance criteria specified in each analytical method.

4.2.3 Data Representativeness

Making certain that sampling locations are selected properly and a sufficient number of samples are collected best satisfies the representativeness criterion. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. The proposed investigation has been designed to supplement sediment quality data derived from previous investigations. Each area of interest has already had some level of characterization (metals in the primary study area and all constituents of interest in the background area), which provided information on the expected range and heterogeneity of constituent concentrations. These results formed the basis of this work plan. As such, data representativeness is assured.

4.2.4 Data Completeness

The number of samples to be collected is based entirely on the project goals, which defines the programmatic level of data completeness. All samples collected in the field must be accounted for in the sample data packages and the data should be 100 percent complete from a deliverables standpoint, as tracked through the sample chain-of-custody process. The level of completeness, with respect to usable data will be measured during the data assessment process by comparing the total number of data points to the number of data points determined to be usable.

4.2.5 QA/QC PROTOCOLS

This section describes the management policies, objectives, principles and procedures that will be used to generate data of the required quality. These protocols include laboratory and field equipment calibration, QC sample collection and analysis, quantitative evaluation of data quality protocols, and as necessary, data qualification.

Analytical Procedures/Calibration

- **Laboratory Methods/Equipment** - All off-site definitive chemical analyses will be performed using USEPA SW-846 methods for the specified analytes (Table 2), by a laboratory that is NYSDOH Environmental Laboratory Approval Program (ELAP) and Contract Laboratory Protocol (CLP)-certified. Laboratory instruments will be calibrated following the referenced SW-846 analytical method protocols. Initial calibrations will be performed before sample analysis. Calibration checks will be performed at the frequencies specified in each analytical method.

The sample collection, preservation, and holding time requirements are listed in Table 3. Quantitation and detection limits for all analyses are those specified under the appropriate test methods, with the exception of benzene in water, which requires a minimum quantitation limit of 0.7 ug/l for this project.

- **Field Methods/Equipment** - Qualitative organic vapor analysis will be performed on-site using a photo-ionization detector (PID). Calibration will be performed with certified calibration gases, in accordance with the manufacturer's specifications, and calibrations will be checked daily during the field investigation program. Field instruments measuring temperature, conductivity, dissolved oxygen, pH, turbidity etc., will be calibrated in accordance with the manufacturers' specifications, and checked daily. Results of field calibrations and calibration checks will be maintained in the field logbook.

5.0 HEALTH AND SAFETY PLAN

Standard Health and Safety (H&S) practices shall be observed according to the site-specific Health and Safety Plan (HASP) to be provided by the USEPA sampling team.

6.0 REFERENCES

- U.S. Army Corps of Engineers (USACE). 2003. Site Investigation Gowanus Bay and Gowanus Canal Kings County, NY, Final Report Volume 1. USACE Baltimore District. Baltimore, MD.
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- USEPA. 1992. Sediment Classification Methods Compendium. EPA 823-R-92-006. Office of Water. Washington, D.C.
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- USEPA. 1994. EPA's Contaminated Sediment Management Strategy. EPA 823-R-94-001. Office of Water. Washington, D.C.
- USEPA. 2001. Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA-823-B-01-002. Office of Water. Washington, D.C.

Figures



Figure 1

SITE LOCATION MAP
GOWANUS CANAL PHASE II
BROOKLYN, NEW YORK



285 DAVIDSON AVENUE, SUITE 100
SOMERSET, NJ 08873
(732) 302-9500



Figure 2
 SAMPLE LOCATION MAP
 BROOKLYN, NEW JERSEY



285 DAVIDSON AVENUE, SUITE 100
 SOMERSET, NJ 08873
 (732) 302-9500



Figure 3

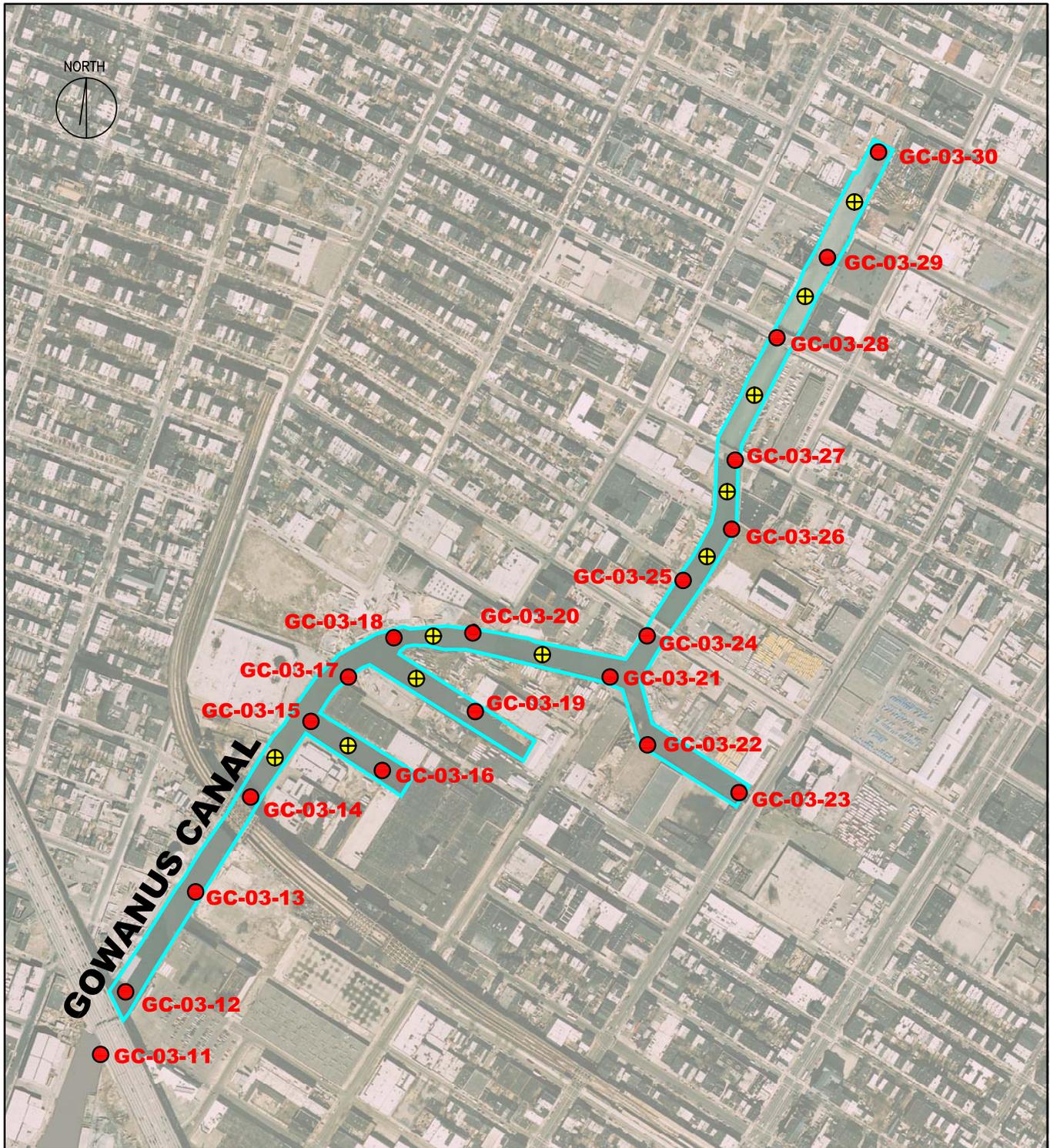
HAZARD SCORES FOR HISTORIC SAMPLE LOCATIONS
GOWANUS CANAL PHASE II
BROOKLYN, NEW JERSEY

● EXISTING SAMPLE LOCATIONS

(185) BENTHIC HAZARD SCORES



285 DAVIDSON AVENUE, SUITE 100
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- EXISTING SAMPLE LOCATIONS
- ⊕ PROPOSED SAMPLE LOCATIONS

Figure 4

PROPOSED SAMPLE LOCATION MAP
GOWANUS CANAL PHASE II
BROOKLYN, NEW JERSEY



285 DAVIDSON AVENUE, SUITE 100
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Tables

Table 1
Constituents Exceeding Sediment Benchmark Values Per Sample Location

CG - 03 - 27	CG - 03 - 28	CG - 03 - 29	CG - 03 - 30
Antimony	Antimony	Antimony	Antimony
Arsenic	Arsenic	Arsenic	Cadmium
Cadmium	Cadmium	Cadmium	Chromium
Chromium	Chromium	Copper	Copper
Copper	Copper	Lead	Lead
Lead	Lead	Mercury	Mercury
Mercury	Mercury	Nickel	Nickel
Nickel	Nickel	Silver	Silver
Silver	Silver	Zinc	Zinc
Thallium	Zinc	Dieldrin	Dieldrin
Zinc	Dieldrin	Aroclor 1260	Aroclor 1260
TPHC	Aroclor 1260	Naphthalene	Naphthalene
Naphthalene	Naphthalene	2-Methylnaphthalene	2-Methylnaphthalene
Acenaphthylene	2-Methylnaphthalene	Acenaphthylene	Acenaphthylene
Acenaphthene	Acenaphthylene	Acenaphthene	Acenaphthene
Fluorene	Acenaphthene	Dibenzofuran	Dibenzofuran
Phenanthrene	Dibenzofuran	Fluorene	Fluorene
Anthracene	Fluorene	Phenanthrene	Phenanthrene
Fluoranthene	n-Nitrosodiphenylamine	Anthracene	Anthracene
Pyrene	Phenanthrene	Fluoranthene	Fluoranthene
Benzo(a)anthracene	Anthracene	Pyrene	Pyrene
biz(2-Ethylhexyl)phthalate	Fluoranthene	Benzo(a)anthracene	Benzo(a)anthracene
Benzo(b)fluoranthene	Pyrene	Chrysene	Chrysene
Benzo(g,h,i)perylene	Benzo(a)anthracene	biz(2-Ethylhexyl)phthalate	biz(2-Ethylhexyl)phthalate
Acetone	Chrysene	Benzo(b)fluoranthene	Benzo(b)fluoranthene
2-Butanone	biz(2-Ethylhexyl)phthalate	Benzo(g,h,i)perylene	Dibenz(a,h)anthracene
	Benzo(b)fluoranthene		Benzo(g,h,i)perylene
	Benzo(g,h,i)perylene		
	Acetone		
	Carbon Disulfide		
	2-Butanone		
	Ethylbenzene		
	m+p - Xylenes		
	o - Xylenes		

Notes:
Highlighted constituents - No sediment benchmark available.

Table 2

Constituents Exceeding Both Sediment Benchmark Values and Average Background Concentrations Per Sample Location

CG - 03 - 27	CG - 03 - 28	CG - 03 - 29	CG - 03 - 30
Antimony	Antimony	Antimony	Antimony
Arsenic	Arsenic	Copper	Cadmium
Copper	Cadmium	Lead	Copper
Lead	Copper	Zinc	Lead
Silver	Lead	Dieldrin	Mercury
Thallium	Nickel	Naphthalene	Silver
Zinc	Silver	2-Methylnaphthalene	Zinc
TPHC	Zinc	Acenaphthylene	Dieldrin
Naphthalene	Dieldrin	Acenaphthene	Naphthalene
Acenaphthylene	Naphthalene	Dibenzofuran	2-Methylnaphthalene
Acenaphthene	2-Methylnaphthalene	Fluorene	Acenaphthylene
Fluorene	Acenaphthylene	Phenanthrene	Acenaphthene
Phenanthrene	Acenaphthene	Anthracene	Dibenzofuran
Anthracene	Dibenzofuran	Fluoranthene	Fluorene
Fluoranthene	Fluorene	Pyrene	Phenanthrene
Pyrene	Benzo(a)anthracene	Benzo(a)anthracene	Anthracene
Benzo(a)anthracene	Phenanthrene	Chrysene	Fluoranthene
biz(2-Ethylhexyl)phthalate	Anthracene	biz(2-Ethylhexyl)phthalate	Pyrene
Benzo(b)fluoranthene	Fluoranthene	Benzo(b)fluoranthene	Benzo(a)anthracene
Benzo(g,h,i)perylene	Pyrene	Benzo(g,h,i)perylene	Chrysene
Acetone	Benzo(a)anthracene		biz(2-Ethylhexyl)phthalate
2-Butanone	Chrysene		Benzo(b)fluoranthene
	biz(2-Ethylhexyl)phthalate		Dibenz(a,h)anthracene
	Benzo(b)fluoranthene		Benzo(g,h,i)perylene
	Benzo(g,h,i)perylene		
	Acetone		
	Carbon Disulfide		
	2-Butanone		
	Ethylbenzene		
	mt-p-Xylenes		
	o-Xylenes		

Notes:

Highlighted constituents - No sediment benchmark or background values available.

Highlighted constituents - No background values available.

Highlighted constituents - No sediment benchmark available.

Table 3

Constituents Exceeding Both Sediment Benchmark Values and Maximum Background Concentrations Per Sample Location

CG - 03 - 26	CG - 03 - 27	CG - 03 - 28	CG - 03 - 29	CG - 03 - 30
Thallium	Thallium	Antimony	Dieldrin	Antimony
Naphthalene	TPHC	Lead	Naphthalene	Lead
2-Methylnaphthalene	Naphthalene	Dieldrin	2-Methylnaphthalene	Silver
Acenaphthylene	Acenaphthylene	Naphthalene	Acenaphthylene	Dieldrin
Acenaphthene	Acenaphthene	2-Methylnaphthalene	Acenaphthene	Naphthalene
Dibenzofuran	Fluorene	Acenaphthylene	Dibenzofuran	2-Methylnaphthalene
Fluorene	Phenanthrene	Acenaphthene	Fluorene	Acenaphthylene
Phenanthrene	Anthracene	Dibenzofuran	Phenanthrene	Acenaphthene
Anthracene	Fluoranthene	Fluorene	Anthracene	Dibenzofuran
Fluoranthene	Pyrene	6-Nitrofluoranthene	Fluoranthene	Fluorene
Pyrene	Benzo(a)anthracene	Phenanthrene	Pyrene	Phenanthrene
Benzo(a)anthracene	biz(2-Ethylhexyl)phthalate	Anthracene	Benzo(a)anthracene	Anthracene
Chrysene	Benzo(b)fluoranthene	Fluoranthene	Chrysene	Fluoranthene
Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Pyrene	Benzo(b)fluoranthene	Pyrene
Benzo(a)pyrene	Acetone	Benzo(a)anthracene	Benzo(g,h,i)perylene	Benzo(a)anthracene
Benzo(g,h,i)perylene	2-Butanone	Chrysene		Chrysene
Acetone		biz(2-Ethylhexyl)phthalate		biz(2-Ethylhexyl)phthalate
Carbon Disulfide		Benzo(b)fluoranthene		Benzo(b)fluoranthene
2-Butanone		Benzo(g,h,i)perylene		Dibenz(a,h)anthracene
cis-1,2-Dichloroethene		Acetone		Benzo(g,h,i)perylene
Ethylbenzene		Carbon Disulfide		
m,p - Xylenes		2-Butanone		
o - Xylenes		Ethylbenzene		
		m,p - Xylenes		
		o - Xylenes		

Notes:

Highlighted constituents - No sediment benchmark or background values available.

Highlighted constituents - No background values available.

Highlighted constituents - No sediment benchmark available.

Table 4

Summary Location Hazard Rankings

Sample Location	Grand Total	Rank
GC-03-01	48	19
GC-03-02	20	23
GC-03-03	48	19
GC-03-04	98	18
GC-03-05	188	15
GC-03-07	214	14
GC-03-08	21	22
GC-03-09	162	17
GC-03-10	8	24
GC-03-11	185	16
GC-03-12	232	13
GC-03-13	245	12
GC-03-14	411	9
GC-03-17	28	21
GC-03-18	674	1
GC-03-21	591	2
GC-03-22	45	20
GC-03-23	357	10
GC-03-24	483	5
GC-03-25	472	6
GC-03-26	567	3
GC-03-27	324	11
GC-03-28	523	4
GC-03-29	430	8
GC-03-30	458	7

Rank - 1 = Most Hazardous; 25 = Least Hazardous.